

AN
ACCOUNT
OF THE
STRUCTURE of the EYE,
WITH OCCASIONAL
REMARKS on some DISORDERS
of that ORGAN,
DELIVERED IN
LECTURES
AT THE
THEATRE OF SURGEONS-HALL.

BY THOMAS GATAKER,

Surgeon-Extraordinary to her Royal Highness the Princess of WALES,
and Surgeon to St. GEORGE'S-HOSPITAL.

LONDON:

Printed for R. and J. DODESLY, in Pall-Mall; and
G. HAWKINS, at Temple-Bar, 1761.

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TO THE
MASTER, GOVERNORS,
AND
COURT of ASSISTANTS
OF THE
INCORPORATED SOCIETY
OF
SURGEONS OF LONDON.

GENTLEMEN,

THE obliging manner in which you appointed me to the office of reading these occasional Lectures was esteemed by me as a mark of your regard ; nor had I less reason to be satisfied with your favourable behaviour to me at the Theatre. Justly sensible of these civilities, I take this public opportunity of returning you my thanks.

In

DEDICATION.

In compiling the anatomical part of these Lectures, I endeavoured to collect the principal articles of this interesting subject, and to form such an account of the eye and eye-lids as might convey a clear and comprehensive idea of their structure and uses without being tediously circumstantial.

If I have succeeded in my design, as I am encouraged to hope, the trouble I took on the occasion may probably, by this publication, be useful to those who are in pursuit of the same knowledge.

I am,

GENTLEMEN,

With due regard

Your most obedient Servant,

THOMAS GATAKER.

FIRST LECTURE.

THE

INTRODUCTION.

THE subject I have chosen for the following Lectures, is the structure of the eye and eye-lids; a subject which, from its importance in regard to the diseases of these parts, and from the difficulty of acquiring a perfect knowledge of it, will, I imagine, very properly admit of being often explained.

As the employments and the pleasures of life depend, in a great degree, upon the faculty of *seeing*, whatever may interrupt or destroy the use of that faculty deserves our utmost attention. Agreeable to this opinion, we find in all times, that the disorders which affected the sight were considered as objects of importance. Anatomists have taken great pains in discovering the structure of the eye; the arts of physic

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and surgery have been employed to remove or alleviate the diseases of this organ; and to these assistances has been added the result of philosophical enquiries, which, by explaining the nature of vision, have pointed out the means of relief in some cases, wherein neither medicines nor manual operations avail.

With all these advantages, it may seem extraordinary to assert, that disorders of the eyes are frequently treated with far less propriety than many other complaints of a much less interesting nature.

May I be allowed here to mention some of the reasons which induce me to form this opinion?

If we look into the accounts given of the diseases of the eyes, we shall find, that most authors, who have written at large or professedly upon this subject, seem fond of making numerous distinctions of the complaints, and of bestowing particular appellations upon them; multiplying them by this means into such an useless and perplexing variety, that the disorders of the eyes and eyelids are made by some writers almost equal to all the other distempers which ever affected the

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human body. But whatever indulgences of this sort a creative fancy, or a motive less justifiable may induce a writer to take, it ought to be considered, that all distinctions and subdivisions upon these occasions, which are not essentially useful, are in reality prejudicial: they load the memory, and confound the judgment of the unexperienced, and by filling the mind with false and trifling ideas, they prevent in some degree the more plain and necessary circumstances from being properly attended to. In the treatment of tumours formed upon the eye-lids, of what consequence can it be to know, whether any of them resemble a barley-corn, a gravel-stone, or a hail-stone? In the description of some disorders of the eye itself, what an unnecessary and perplexing trouble must it be to determine the figure and size of certain appearances? as whether they are formed like the nail of a man's hand, or like the wing of a bird? or whether they resemble a grape-stone, a small apple, the head of a nail, or the head of a fly? Yet such kind of distinctions are to be met with in writers of the greatest eminence.

Another circumstance to which the want of

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success in these cases seems to be often owing, is, that they are frequently of so complicated a nature as to be incapable of relief, without the united assistance of physic and surgery. Upon such occasions, if a practitioner is unskilled in either of those professions, and wants opportunity or inclination to procure any additional help to his own knowledge and judgment, the patient must necessarily lose part of that benefit which the circumstances of his case would have allowed. The same disadvantage indeed may prevail more or less in the treatment of complaints incident to some other parts of the body; but here the observation serves at least to account for the little real advantage attending the general practices and extraordinary boasts of oculists. The merit of most practitioners of this class consists chiefly in knowing something of the anatomy of the eye, and in the performance of one or two particular operations: In respect to the more comprehensive branches of physical knowledge, as they rarely have any reasonable pretence to these, so their conduct is seldom ingenuous enough to make them either desire or deserve the advantage of such knowledge from those who possess it.

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To the reasons already assigned may be added the following one, which relates more immediately than the others to the business of the present lectures. Some practitioners may not have that thorough knowledge in the structure of the eye, as to enable them in all cases to treat the several disorders of this organ with that judgment and propriety with which they would execute many other parts of their profession. The study of anatomy, it must be owned, has of late years been very much cultivated, and the methods of teaching it have been much improved: but notwithstanding the progress which many students make in this very useful branch of physical education, many of those who attend anatomical courses cannot, I conceive, be reasonably expected to receive from thence all the benefit that could be wished. The time and opportunities which they are allowed for this improvement, are very often unequal to the design. A multiplicity of things are to be learnt; many of them are very minute; and it is extremely difficult to comprehend them perfectly, and to fix them all in the memory from one or two transient views, though accompanied with the most exact and

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ingenious descriptions. A moderate share of knowledge may be acquired by this means in the gross anatomy, but when the finer organs of the body become the objects of attention, greater difficulties occur: repeated examinations and explanations are then necessary, in order to understand perfectly the structure and uses of these delicate parts, and to impress a lasting idea of them upon the mind. Shall I assert too much in saying, that the want of these opportunities of improvement, by repeated inspection and explanations of the parts, is not so well supplied by books as the subject seems capable of? For though there is very little known in anatomy that has not been given to the public, yet the manner in which this knowledge has been communicated, makes the acquisition of it in some instances very difficult to persons who are little acquainted with the subject. Thus, in respect to the structure of the eye, we find some writers have been so concise and imperfect in certain articles, as by no means to answer the full intention of such descriptions: others have been more elaborate and exact, and very much deserve our acknowledgments and attention; but
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in some particulars, I presume, are more diffuse and circumstantial than is generally necessary. The account is also frequently complicated with critical discussions; perplexed, like most other articles in anatomy, with an useless multiplication of names and distinctions; and when particular parts of the eye are described, as is often done, among other things that have not any immediate connection with it, there is not that methodical arrangement of the several parts which leads best to a regular view of the whole.

Though unequal, I fear, to the task of removing every difficulty from the subject, I shall endeavour, at least, that the following Lectures may be as little liable as possible to the objections which I have taken the liberty of making in the preceding paragraph.

The substance of these Lectures will consist, as was before intimated, of a description of the eye and eye-lids; to which will be occasionally added some few remarks relating to the diseases of these parts, and an explanation of the nature and uses of eye-waters, ointments and liniments for the eyes.

Description of the Parts.

T H E E Y E - B R O W S.

PREVIOUS to the description of those parts which more immediately and principally constitute the organ of sight, it may be proper to say a few words on a neighbouring part, the eye-brow.

The eye-brows are raised a little above the even surface of the forehead, by the thickness of the adipous membrane which lies underneath them, and by the shape of the frontal bone in that part. The form and substance of the eye-brows are in general too well known to require any particular description: In different persons they have indeed some peculiarities in regard to their form, and likewise to their size and colour; but these differences, though they often relate essentially to the beauty and expression of the countenance, are not the proper objects of the present account.

The eye-brows admit of two motions, depression and elevation. The first of these is performed

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formed by a muscle peculiar to the eye-brow, and is termed depressor or corrugator supercilii. This muscle is adherent to, and covered by the inferior portion of the frontal muscle, of which it is reckoned by some to be an elongation. It takes its origin in the great angle of the eye, from the superior part of the nasal bone, and running obliquely upwards, is inserted tendinous into the skin of the brow.

The use of this muscle, when it acts singly, is to move its respective eye-brow downwards; but when both these muscles act together, the brows are drawn nearer to one another at the same time that they are depressed. In this action, the skin that covers the lower part of the forehead between the eye-brows, and that which covers the upper part of the nose, is drawn into wrinkles of different directions, as is particularly seen in frowning. The eye-lids are likewise brought closer by this action, and the eyes, it is supposed, are thereby in some degree occasionally defended from dust or other small bodies floating in the air, as well as from the glare of a very strong light.

The elevation of the eye-brows is performed by the frontal muscles, whose fleshy fibres co-

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ver the anterior portion of the frontal bone, and are partly inserted into the skin of the brows. When these muscles contract, they draw up the eye-brows, and at the same time wrinkle the skin of the forehead and move the scalp.

The eye-brows receive blood-vessels from the temporal and frontal arteries; and nerves from a branch of the fifth pair of nerves. This branch, accompanied with an artery proceeding from the internal carotid artery, runs along the periosteum lining the socket of the eye, and passing through the superciliary hole or notch of the frontal bone, is partly bestowed upon the eye-brow and its muscles.

In respect to the general uses of the eye-brows, they are said to intercept the rays of strong light falling in some oblique directions from above; but though probably they are seldom of much service on this account, they are certainly very useful in preventing rain, sweat, or other moisture from running immediately off the forehead into the eyes: this they do, by directing the course of such moisture either along the sides of the nose, or down the temples.

It might seem proper likewise in this place,

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as a preliminary article to the following description, to give some account of the orbit or bony socket, in which the greatest part of the organ of sight is contained: but as the general form and the general use of this bony cavity are well known, and as several bones contribute to the formation of it, which are subservient likewise to other purposes, a regular description of it here will be omitted. In the course of the following account, different parts of the socket will necessarily be mentioned, and whatever relates in this respect essentially to explaining the present subject, shall be occasionally observed. The next parts to be considered therefore are the eye-lids.

T H E E Y E - L I D S.

TH E eye-lids are connected to the circumference of the socket by the tunica conjunctiva, which will be particularly described hereafter with the coats of the eye. It is necessary, however, to observe here in general of the tunica conjunctiva, that it is a very smooth and fine membrane, which lines the internal surface of the eye-lids, and from the edge
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of the socket, to which it adheres all round, is reflected upon and covers the anterior half of the globe of the eye.

The eye-lids are composed of the common teguments, a cartilage called tarsus, and an internal membrane. They have two angles or corners, one the small or external, the other the large or internal angle. The form of each eye-lid is that of a segment or portion of a circle, and in regard to the eye is such, that when both eye-lids are shut they make a uniform arch, adapted to the convexity of the eye, and in contact with it: but in regard to one another when shut, their edges are so contrived, that they leave a sort of groove or channel between them, which is narrow towards the outer angle, and wider towards the inner, and serves to conduct the tears as they come from the upper part of the eye, to what are called the lacrymal points. The margin of each eye-lid being of considerable thickness, is divided into the outer and inner edge. It is the outer edge only of each lid that is supposed to join when the eye-lids are shut; the inner edge being formed oblique or slanting, makes the
groove

groove or channel just mentioned for the passage of the tears to the lacrymal points.

The outer edge of each eye-lid is furnished with a row of hairs. These hairs are designed to prevent dust or other small bodies flying in the air, from being admitted to the ball of the eye, by the immediate warning which they give to shut the eye-lids when any such bodies touch them. They serve likewise in some measure to defend the eyes against the impressions of very strong light. The loss of these hairs, which happens sometime from disorders in the lids, shews the utility of them in their natural state and situation. The eye-lids, in such cases, are often disagreeably irritated, even by the common light, and are kept almost in constant motion, either on that account, or to prevent dust or other small substances from being admitted and lodging upon the eye.

On the internal edge of each lid is a row of small holes, which are the excretory ducts of what are termed the ciliary glands. These glands, which are likewise distinguished by the name of Meibomius's glands, appear of a whitish colour, and are situated on the internal
surface

surface of the eye-lids, immediately under the tunica conjunctiva. Their ducts, which are extremely short, open at the internal edge of each lid, and when squeezed, yield a kind of oily or unctuous matter. This matter is supposed to be of use in preventing the attrition of the eye-lids from their frequent motion; and by keeping their edges moist and soft, it serves in a great degree to hinder them from being inflamed and excoriated, and from adhering to one another.

Under the external teguments of the eye-lids is the thin cartilage, called tarsus, which forms the chief part of the edge of each lid. The tarsus of each lid is different in respect to its breadth and figure. In the lower lid it is narrow, and nearly of an equal breadth all along; in the upper lid it is broader in general than in the lower, and rising in its middle and superior part, is of a semilunar shape. From the superior edge of the upper tarsus, and the inferior of the lower, is continued a membranous expansion to the neighbouring edge of the orbit. Each of these membranes together with its respective tarsus, has the form of the eye-lid to which it belongs, and is called *ligamentum tarfi*. The
tarfi

tarfi are concave towards the globe of the eye, and convex on the other fide; and upon their internal furface are tranfverfe channels for the reception of the ciliary glands before-mentioned. By the firm fubftance of the tarfi, and by their form, they ferve to ftrengthen and to keep the lids fmooth, and equally extended, fo that they may be freely moved alike in every part; and they make that arch by which the internal furface of the eye-lids is adapted to the convexity of the eye.

The infide of the lids is lined with a fine and very fenfible membrane, which is a portion of the tunica conjunctiva, as has been already obferved and as will appear more particularly hereafter.

The mufcles fubfervient to the motions of the eye-lids, are the mufculus orbicularis, and the levator palpebræ fuperioris.

The mufculus orbicularis furrounds and covers both lids. The origin of this mufcle is at the great or internal angle of the eye; and the fibres of it fpreading from thence and covering the lower lid, proceed on to the outward or leffer angle: paffing round this angle they are continued over, and cover
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the upper lid, and then terminate at the great or internal angle where they began. This muscle has a slight ligamentary tendon, which extending transversely from the nasal process of the maxillary bone towards the internal angle of the eye, and appearing like a white line, terminates at the union of the lacrymal points.

The use of this muscle is by its contraction, to bring the upper lid downwards, and pull the lower lid upwards, by which means both lids are drawn together so as to shut upon the eye.

The levator palpebræ superioris arises from the bottom of the orbit by a small tendon; and as the fleshy fibres of this muscle pass over the globe of the eye, they gradually spread, and afterwards terminate by a broad tendinous expansion in the superior part of the tarsus belonging to the upper lid. The use of this muscle is to open the eye, by drawing the eye-lid upwards.

The integuments of the eye-lids, and the orbicular muscle, are furnished with blood by ramifications from the angular, temporal, and frontal arteries; and these communicate with branches that are sent to the internal membrane of the eye-lids. The levator palpebræ superioris receives a ramification from a considerable

siderable branch, which is sent through the inferior orbital fissure from the internal maxillary artery, and is distributed to this and several other parts of the eye.

The veins of the eye-lids correspond pretty nearly with the course of the arteries, and emptying themselves into the neighbouring veins of the temples and face, have their blood carried by them into the external jugulars.

The eye-lids are supplied with nerves from the ophthalmic branch of the fifth pair. The orbicular muscle of the eye-lids receives nerves from the same branch; likewise from another branch of the fifth pair, called the superior maxillary branch, and from the portio dura of the seventh pair.

The levator palpebræ superioris receives a branch from the third pair.

The eye-lids serve as a veil or curtain, which may be closed or opened at pleasure by the action of their muscles. When they cover the eyes intirely, as in sleep, they exclude the light, which otherwise would hinder rest. They prevent the eyes from growing dry and uneasy, and defend them from being injured by a

variety of small bodies, which might fall upon them from the common air. Even the softest, purest air, and the mildest light, would create very painful sensations in the globe of the eye, if it was intirely divested of this most useful covering. In the day, the eye-lids form a sort of shade, and occasionally moderate the influx of light into the eye. The frequent motion of them serves also to spread the tears or lacrymal fluid over the anterior surface of the globe of the eye, and by that means washes off and cleanses it from any foulness which may have been collected there. By the same means the transparency of the cornea is preserved. Nor is this frequent motion of the eye-lids, which is so necessary for the purposes just mentioned, at all inconvenient in respect to vision; as the quickness of the motion prevents its being any continued and perceptible obstruction to the free passage of the rays of light into the eye.

The eye-lids are subject to little tumours either in their substance or on the surface of them, which fanciful writers have divided into several kinds, and have distinguished by particular names from a resemblance which they conceived they had to some other things,

things, as hail-stones, barley-corns, &c. Of these it is sufficient to say, that a person who is well acquainted with the structure of the parts and with the plain rules of surgery, will find very little difficulty in the treatment of them, further than the common difficulty of handling or applying dressings to parts which are constantly in motion, as well as contiguous to so tender an organ as the eye. But there is one complaint of the eye-lids, which may deserve more particular mention in this place. This disorder chiefly affects the ciliary glands, and is the occasion of that redness which is sometimes observable along the edges of the lids, attended with excoriation, and a discharge of humour. Different methods may be properly directed for the cure or relief of this disorder in different circumstances of it; but there is one which is not so generally attended to as others, and which in some instances has been found successful, after other means, both internal and external, have proved ineffectual. A prudent use of the lunar caustic to the parts has answered this purpose; probably by very powerfully constringing and strengthening the excretory ducts of the ciliary glands, which

a long determination of humours to them has relaxed and enlarged; and by drying up and healing those excoriations of the orifices of these ducts and of the neighbouring skin, which have been produced by the discharge.

The parts next to be considered are the lacrymal gland, the lacrymal points, and the lacrymal bag; the first serving to secrete the lacrymal fluid to be diffused upon the anterior surface of the eye, the two last serving to carry off this fluid after it has answered the purposes for which it was separated. To these may be added, the lacrymal caruncle.

The GLANDULA LACRYMALIS, PUNCTA LACRYMALIA, SACCULUS LACRYMALIS, and CARUNCULA LACRYMALIS.

GLANDULA LACRYMALIS. In the upper part of the socket, a little above the external angle, is a depression which receives the superior part of the glandula lacrymalis. This gland, which was formerly termed glandula innominata, is situated behind the tunica conjunctiva, and is considerably large. It is of a whitish colour, and is composed of several

small lobes, each of which, it has been said, sends out an excretory duct. But though the number of these ducts is not easily determinable, it is certain there are such ducts, which piercing obliquely the tunica conjunctiva of the upper lid, open on the inside of that membrane, near the superior part of the tarsus.

The office of the lacrymal gland is to separate a lymph or fluid, which passes through the excretory ducts, to be diffused over, and to moisten the fore-part of the eye-ball; which might otherwise grow dry, and become painful from the friction of the lids, and the action of the air upon it. And in order that this constant supply of fluid may be properly diffused, there is a frequent motion of the lids which spreads the fluid equally. By this moisture likewise, any foulness between the eye-ball and lids may be washed off.

It is observable, that when any extraneous, irritating substance is accidentally lodged upon the eye and excites pain, an unusual quantity of this lacrymal fluid is immediately separated, and is diffused over the fore-part of the globe, in order to carry off the cause of the irritation. The assistance which nature furnishes

thus for relief of such accidents, and likewise the profusion of the lacrymal fluid, which is instantaneously separated and flows from the eyes upon sudden and violent fits of crying, are circumstances very extraordinary, considering there is not any collection or visible reserve of lymph to answer occasionally these purposes. And here, though it is not a remark essentially relative to practice, it may not be amiss to take notice, that the generality of brute animals are furnished with nearly the same apparatus for the secretion and conveyance of the lacrymal fluid, and the same purposes seem to be answered by this fluid in them as have been observed to be in man, except in the last instance. It is a quality peculiar to the human species, to shew the passion of grief by a sudden and involuntary discharge of tears; unless we admit of a few exceptions, which are imperfect in their kind, and are but barely allowable at all.

PUNCTA LACRYMALIA. Upon the inner edge of each eye-lid, near the internal angle, is a small eminence, which is perforated obliquely by a fine orifice. These orifices, which are situated opposite to one another, are termed lachry-

lacrymal points; and they serve as waste-pipes to carry off the lacrymal fluid after it has answered the purposes already mentioned, upon the anterior surface of the eye. The manner in which this fluid is directed along the groove, formed by the eye-lids to the lacrymal points, has been before taken notice of; but in order that the course of the lacrymal fluid may not be obstructed after it arrives at the lacrymal points, it is necessary that these orifices should be constantly kept open, or at least that they should never be totally closed. To this end, each of the lacrymal points is incircled by a white cartilaginous ring, the direction of which inclining a little obliquely towards the globe of the eye, they never come into contact with one another intirely; but when the eye-lids are slightly shut, the lacrymal points touch each other only at that part next the outer edge or external skin; and when the eye-lids are quite shut, they are still kept at nearly the same distance from one another, by the interposition of a small round substance in the corner of the eye, called the lacrymal caruncle.

It must be further observed, in regard to these lacrymal points, that they are the orifices

of two short ducts, which run behind the tendon of the orbicular muscle, and which uniting near the lacrymal sac, form one duct that immediately opens, beyond the angle of the eyelids, into the upper part of the sac.

The course of these ducts, as they run behind the tendon of the orbicular muscle, may deserve consideration in respect to the operation for a fistula lacrymalis. It was long, we know, supposed, that a transverse incision of this tendon might occasion an inversion or distortion of the eye-lid; and therefore, in performing that operation, particular directions were given to avoid this circumstance. This precaution has indeed of late been almost intirely disregarded. Since, however, it is supposed by some, that from such a division of the tendon, these ducts of the lacrymal points may happen to be wounded; and as the divided parts of the ducts may possibly not heal afterwards so aptly as to admit a free passage of the lacrymal fluid through them, it should seem right to prevent this accident where it can be done with propriety. For this purpose, one of the methods which was formerly proposed of beginning the incision immediately below the
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tendon, in order to avoid wounding the tendon, particularly in those cases where there is little or no external swelling, appears a reasonable practice in one respect, as it will certainly prevent a division of the lacrymal ducts.

The *SACCULUS LACRYMALIS*. The lacrymal sac is described to be an oblong membranous bag, and, if seen in a state of distention, it has that appearance. The prints which we have of it give it likewise the same figure, representing it uniformly distended. It ought however to be observed, that in a natural state of the lacrymal sac, in which the tears have a free passage through it, the anterior side of it suffering no distention, is nearly flat. The upper part of the sac lies under the tendon of the orbicular muscle, and receives the tears from the lacrymal points by the ducts just taken notice of. Near the middle, which is the widest part of the bag, it is somewhat less than a quarter of an inch in diameter; but descending a little lower it gradually lessens, and passing obliquely backwards, terminates by a very small opening, under the *os turbinatum inferius*, in the cavity of the nostril. The lacrymal bag is situated just within the orbit, in a
bony

bony passage, formed by the os unguis and the os maxillare. The length of this passage is about three quarters of an inch, the greatest part of which is to be considered as a groove, the anterior surface of the bag for about the space of half an inch, not being covered with bone. The remaining narrower part of the passage is formed into a complete canal, which incloses the contracted and shorter part of the bag, as it passes into the nostril.

Whoever duly considers the situation of the lacrymal sac, as it lies in the passage just described within the edge of the socket, will perceive, I imagine, that a proper compression of the sac (however useful such a compression might be, could it be easily made) is not generally so practicable as some have thought it to be in the cure of a fistula lacrymalis. Less still will be expected from this method of compression, when it is considered, that the disease generally beginning with an obstruction in that part of the passage which forms the complete bony canal above-mentioned, this obstruction must be first removed before any effectual progress can be made by other means towards a real cure of the disorder.

The structure and uses of the parts described in this and the preceding article, ought, in general, to be strictly attended to, in order to conceive rightly of the operation for the fistula lacrymalis. Many other circumstances are necessary to be likewise attended to in regard to the management of that complaint; but as these have been treated of by the best of our modern writers on the operations of surgery, and as the subject has been elaborately considered very lately, I am precluded from saying more upon it at present.

CARUNCULA LACRYMALIS. The lacrymal caruncle is situated between the internal angle of the eye-lids, and the ball of the eye. It is a small reddish substance, and has the appearance of being fleshy, though it is thought to be glandular. It is said to have a great number of very fine hairs upon its surface, and to be covered with an oily, yellowish matter, not unlike that which is discharged from the ciliary glands. These hairs, it is supposed, serve to stop and prevent any feculencies or extraneous substances from entering into, and obstructing the lacrymal points; a use that is ingeniously enough applied, if the existence of these hairs

was

was really ascertained. The caruncle itself, as was intimated in the preceding article, by its situation in the corner of the eye, serves to prevent the internal edges of the lids at that part from ever coming quite into contact with one another; and thereby the orifices of the lacrymal points being to a certain degree kept open, the tears or lacrymal fluid pass freely through these points into the sac.

The lacrymal gland, points, bag and caruncle, receive arteries from the maxillary and temporal branches, and nerves from the optic branch of the fifth pair.

SECOND LECTURE.

Of the form and coats of the Eye, and of
the Optic Nerves.

THE figure or natural form of the eye is that of two unequal portions of unequal spheres. The portion of the smaller sphere is situated anteriorly; the portion of the larger sphere makes the posterior part of the eye. If the eye had been one sphere, the distance from the cornea through the center of the eye to the retina would have been so short, that the focus of the rays of light would have fallen beyond the eye, and vision would have been confused.

In considering the particular parts of the eye, they may be divided into the coats and the humours; to which may be added, the muscles.

Of the Coats of the Eye.

The coats of the eye are the tunica conjunctiva, or adnata; the sclerotica and cornea;

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nea; the choroides with the uvea or iris; and the retina. To these may be added, the capsular tunics of the crystalline and vitreous humours, which will be taken notice of in the description of those humours.

The Tunica conjunctiva.

Some anatomists divide the tunica conjunctiva, adnata, or as it has been sometimes termed, though improperly, albuginea, into different membranes. One of these is said to be a continuation of the periosteum lining the socket, the other a continuation of the internal membrane of the eye-lids; both of them are said to pass from the edge of the socket over the anterior part of the eye to the termination of the sclerotica in the cornea; and likewise to be covered with an extreme fine membrane, proceeding from the scarfskin of the eye-lids. But without pursuing any further account of these, it may be sufficient to observe, that though the conjunctiva may sometimes admit of being divided into distinct laminae, as may be done in other membranes where no such distinction is observed, yet as the division

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here is far from being easily practicable, and as the distinction does not appear to have any real use, it may be properly ranked amongst the many other articles which can serve only to burthen the memory.

The tunica conjunctiva, therefore, the origin of which is not well determined, may be considered as one membrane, which lines the internal surface of the eye-lids, and which, from the edge of the socket, to which it adheres, is reflected upon, and covers the anterior half of the globe of the eye; the part of this membrane which lines the lids being distinguished as the conjunctiva of the eye-lids, the portion of it that is spread upon the globe, as the conjunctiva of the eye. The conjunctiva of the eye-lids adheres closely to the internal surface of the tarsus. It is full of capillary blood-vessels, which appear very plainly, and it is said to be perforated with numerous small orifices, through which a lymph constantly passes, serving with the tears to moisten the inside of the eye-lids, and the anterior surface of the eye. This portion of the tunica conjunctiva is endued with a remarkable degree of sensibility, as is known by the extreme pain which some-

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sometimes ensues from dust or other irritating substances accidentally lodging upon this part. The conjunctiva of the eye, which adheres all round to the edge of the socket, and from which circumstance probably it has been supposed to have its origin from the periosteum lining the socket, is loosely connected to the eye by a reticular substance, as far as where the sclerotica is said to terminate in the cornea. Here it has been thought that the conjunctiva ends, or changes its nature and becomes one with the cornea; but by a careful dissection it may be separated from the whole surface of the cornea.

It may be proper to add here, that immediately under and adherent to the conjunctiva of the globe, is situated the tendinous expansion of the four straight muscles of the eye; which expansion by its internal surface adheres closely to the forepart of the sclerotica, and covering all that part of the globe which appears white, terminates at the edge of the sclerotica. Some have given the name of tunica tendinea to this expansion. It is the colour of this tendinous substance, and of the anterior part of the sclerotica, in which at last this expansion is lost,

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lost, that chiefly forms, what is commonly called the white of the eye; for though the conjunctiva has been supposed to produce this colour, and from thence probably received one of its names, albuginea, yet in reality the conjunctiva, though whitish, does not afford much colour of itself, but being transparent, the colour of these subjacent parts is seen strongly through it.

The temporal and frontal arteries send branches to the tunica conjunctiva, and these branches communicate with those which are sent to the integuments of the eye-lids, and to the orbicular muscle. The same membrane is likewise supplied with blood-vessels, by means of the internal maxillary artery, which sends a considerable branch into the socket, where it divides, and spreading into various ramifications, is distributed to several parts of the eye, and amongst others, to the tunica conjunctiva. The vessels of that portion of this membrane, which have been distinguished by the name of conjunctiva of the eye, are chiefly such as in their natural state carry only lymph or serum, and are not visible unless made so by anatomical injections; or else,

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when in the living subject, they are accidentally distended with blood in inflammations of the eye; or when the blood is admitted into and stagnates in them, by a mere weakness or relaxation of these vessels.

The admission of blood into these vessels, is a circumstance which frequently deserves attention in disorders of the eyes. The eyes we know are subject to inflammations from a variety of causes, in most of which, not only the sanguinary vessels of the conjunctiva are fuller and more distended than is common, but the blood, as was before intimated, is likewise thrown into the numerous lymphatic vessels, and occasions chiefly that general appearance of redness which attends these disorders. The method of treating these inflammations in their first state, is sufficiently obvious; but there is a time in many of these cases, (to be judged of by the general indications, and by the means of cure that have been already made use of,) when the redness and fullness of the vessels will in a great degree remain, and yet to pursue the same method of cure as was at first directed, would be very improper. The truth is, the fine lymphatic vessels,

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vessels, which either from fullness, heat, or other general cause in the constitution, have had the blood thrown into them, will for a considerable time admit the same after the original cause of the disorder is removed : They are now so relaxed and weakened by the distention which they have suffered, that they still admit the blood, for want of power to contract themselves to their natural diameter, and thereby to resist the influx of it into them.

Upon this occasion it may not be improper to take notice of those external applications, which are known by the names of eye waters, liniments, or ointments for the eyes.

Among the variety of medicines which are distinguished, as being *good* for particular complaints, there are few that have been more celebrated, than certain compositions for the disorders affecting the eyes and eye-lids. Most of these are recommended indiscriminately for almost every complaint of these parts ; in which kind of practice it is not to be supposed, that any just idea of the medicine directs the use of it. On the other hand, the real properties of these medicines are not, I conceive, suffi-

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ciently explained, where a more intelligent method might have been expected. Most writers upon the distempers of the eyes, recommend applications of this sort, but they either speak of them in too general terms, without attempting to shew wherein their proper use consists, or they give a partial and undeserved preference to some particular composition. In fact, these medicines are almost all capable of doing service, under certain circumstances of the distemper; but as the advantages arising from a promiscuous use of them, must be owing rather to accident than judgment, the manner in which they may be supposed to act ought to be attended to. If we examine into the ingredients of these compositions, we shall find the basis of them is more or less of a restraining nature, and it is from this property that they are capable of doing service by contracting and thereby strengthening the vessels, which have been too much distended. In some cases a different form of these medicines may agree better than others; a liniment may be preferable to a water, or a water to a liniment, according to the nature or quantity of the discharge, with other circum-

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circumstances : besides that there is a peculiarity in some constitutions, which will not admit of the same means of cure, either external or internal, as are effectual in other people, and this is particularly true in the present case, in regard to unctuous applications—So likewise the strength of the medicine, with respect to its degree of restringency, is to be observed ; and what is still of great consequence, the preparing or compounding these medicines ought to be done with the utmost exactness and neatness, that no rough particles may come in contact with the eye, which may create any unnecessary irritation there. These precautions being attended to, the applications just mentioned may be often employed with the greatest advantage ; and when the principle upon which they are directed is properly considered, it is easy to see that many forms or compositions of these medicines will equally answer the purpose, without attributing any specific property to them.

The nerves of the tunica conjunctiva proceed from the opthalmic branch of the fifth pair.

In regard to the uses of the tunica conjunctiva,

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as a ligament to connect the eye to the edge of the socket, and, being of a texture admitting some extension, it allows, notwithstanding this connection, of a free movement of the eye in different directions without pain or inconvenience. Also by the adhesion of this membrane all round to the edge of the socket, any foulness collected on the eye, or any irritating substance accidentally lodging upon it, are prevented from passing to the back part of the globe; an accident which might produce extreme pain, and could not without great difficulty be relieved. This membrane likewise gives a smoothness to the parts which it covers, and thereby makes the friction less considerable between the eye and the eye-lids.

Previous to the description of the other coats of the eye, it may be necessary to give some account of the optic nerves.

OF THE OPTIC NERVES.

THE optic nerves are two thick, round, and whitish bodies or chords, which arise pretty near each other, from two considerable eminences in the brain, termed thalami

thalami nervorum opticorum. From thence they pass in an incurvated course outwards and forwards, but approach each other afterwards, and seem to unite before that part of the brain called infundibulum. After this seeming union of the optic nerves, they divide, and are sent separately through their proper orifices in the sockets, to the posterior part of the eye-balls, where their coats and nervous substance are supposed to be expanded and continued on, as will be more particularly expressed hereafter, to form the different coats of the eye.

The insertion of the nerve is not directly opposite to the center of the pupil, but a little on the inside towards the nose; the reason of which will be explained in the description of the retina.

The substance of the optic nerves consists of medullary fibres, which are productions of the medullary substance of the brain. They are covered only with the pia mater, till they reach the orifices through which they pass into the socket: there the dura mater gives them another covering, which is continued on with the first.

Different opinions have arisen about the

seeming union of these two nerves before the infundibulum. Some think that they cross one another here; others, that their substance is mixed and blended together; and others imagine that there is only a strict cohesion of the two nerves, without any mixture of their substance, an opinion which seems to have been warranted by observations related by writers.

To return now to the description of the remaining coats.

OF THE SCLEROTICA AND CORNEA.

THE sclerotica and cornea are mentioned by some anatomical writers as two different coats of the eye, though they are now generally allowed to be only two different names to signify different parts of the same coat; the sclerotica being the external coat of the posterior part of the eye; the cornea, the external coat of the anterior part: others distinguish these two portions of this membrane, into cornea opaca and cornea lucida; by the first, understanding the posterior portion; by the latter, the anterior.

Till of late, it was the general opinion of anatomists, that the three different principal coats of the eye, were continuations and expansions of the different substances of the optic nerve; that is, the sclerotica was thought to be a production or continuation of the covering which this nerve receives from the dura mater; the choroides was supposed to proceed from the second coat of the optic nerve, arising from the pia mater; and the retina was said to be an expansion of the medullary substance of this nerve. These continuations or expansions are not now generally allowed, as they cannot be sufficiently and perfectly ascertained by laying open and examining the course of the optic nerve: on the contrary, by examining this nerve, and comparing the structure of it with the sclerotica, the choroides, and the retina, there appears to be a considerable difference between the texture and thickness of these membranes and the texture and thickness of the parts whence they are supposed to be derived and continued. But though the force of this objection may have some effect against the common theory, yet, as other reasons are brought

brought to invalidate this objection, and as the origin of these coverings to the humours of the eye is not otherwise well accounted for, it may be proper to retain the old opinion till a more certain one is established.

The sclerotica then, or the external coat of the posterior part of the eye, may be said to be a production of the dura-matral coat of the optic nerve. In man it is inelastic. This disposition in the sclerotica appears to be particularly useful ; for as it is necessary to alter occasionally the convexity of the cornea, in order to adapt the eye to the different distance and magnitude of the object to be seen ; and as in one instance which will be mentioned hereafter with the muscles, this alteration is supposed to be effected by drawing the eye backward into the socket, and pressing it against the fat contained there, by which means the humours of the eye being protruded forwards, the cornea, which is elastic, is rendered more or less convex ; if the sclerotica had been as capable of being distended as the cornea is by its elasticity, this pressure would have been lost : the convexity of the cornea would consequently have remained unaltered, as the

coats of the eye would have given way in every part alike. The sclerotica is made up of several laminæ closely connected, whose fibres run in different directions, and form a dense, compact substance. It is opaque, and also of considerable thickness, particularly in the posterior part where the optic nerve enters; but it gradually grows thinner towards its anterior part: here we see a change of appearance, and the external coat of the anterior part of the eye, from a fancied resemblance to transparent horn, takes the name of cornea.

The cornea consists of two principal laminæ, an external and an internal, each of which is composed of thinner laminæ. The substance of the cornea is, as was before observed, in some degree elastic, that, in order to fit the eye to the different magnitudes and distances of objects, its convexity might be rendered greater or less, as the humours of the eye are more or less protruded: it is likewise perforated with a great number of exceeding small orifices, thro' which a very fine fluid is supposed to be constantly discharged, but which soon evaporates.

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The sclerotica and cornea are furnished with arteries chiefly from a branch of the internal carotid, which entering the socket with the optic nerve, gives, amongst other ramifications, several which run into the posterior portion of the sclerotica : of these, some are distributed into the different parts of this membrane, whilst others, after running a little way obliquely in the substance of it, penetrate through it, and pass on to the next coat, the choroides.

The nerves proceed chiefly from the optic branch of the fifth pair, which running into the substance of this membrane, some, like the blood-vessels, are sent into the different parts of it ; whilst others, after passing a little way in the substance of the sclerotica, penetrate through it, and are continued on between the sclerotica and choroides towards the iris, having the appearance of fine ligaments.

The sclerotica and cornea serve in general to enclose and cover the humours of the eye : the cornea, in particular, serves to transmit the rays of light into the eye, and produce the first refraction of those rays necessary to vision.

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The natural transparency of the cornea, so necessary for the admission of light into the eye, is liable to be altered and obscured by inflammations or humours affecting the fore-part of the eye, the frequent consequences of which, where they remain any time, are a thickening of particular parts of the cornea, imposthumations in this membrane, or ulcerations: these are apt to leave opaque marks or spots in the cornea, which according to their size or situation, intercept more or less the rays of light, and are with much difficulty, if at all removed, especially in grown people. A very large number of those unhappy persons, who, from a defect or total loss of sight, live uncomfortably to themselves, and burthensome to their friends or the community, owe their misfortune in this respect, to the want of early application for assistance, or to that assistance being administered less speedily than the nature of such cases generally requires, whence the spots or marks before-mentioned. It cannot therefore be too often and too earnestly inculcated, that every suitable method for relief should be employed here with the utmost expedition.

THE CHOROIDES.

AMONG the variety of instances in anatomy, where the subject is perplexed by different distinctions, this membrane is one. From its resemblance to the chorion, in respect of its numerous blood-vessels, it appears originally to have had the name of choroides. From some fancied similitude to a grape in regard to its form and colour, the whole or part of this membrane had likewise the name of uvea given to it. Among the moderns, some divide it into two parts, calling the posterior portion, choroides, the anterior uvea, and the external surface of the latter, on account of the variety of its colour, iris. Others call the whole anterior portion iris, reserving the name of choroides to signify as usual the posterior portion of this membrane ; and this last distinction will be observed in the present account.

The choroides is situated within the sclerotica, lying contiguous to the inner surface of it, and derives its origin, according to the most generally received opinion, from the second or pia-matral covering of the optic nerve. When the sclerotica is removed, the choroides appears

pears of a dark-brown or blackish colour. The choroides is divided into two laminæ, the external of which is slightly connected to the sclerotica, and is covered with a black substance interposed between it and the sclerotica. Both laminæ are extremely vascular, but the internal is furnished with a great number of inosculating blood-vessels, whose almost innumerable extremities project from its inner surface, and have been termed by some writers villi and papillæ ; and this lamina being first distinguished by Ruysch, has the name of tunica Ruyschiana. The same black substance which, as was just now observed, covers the external surface of the choroides, being interposed between that and the sclerotica, appears also on the internal surface of this membrane between it and the retina. Some reckon this black substance, which has been considered by writers as a pigment, to be an exceeding fine membrane analogous in its texture, to what is termed in anatomy the rete mucosum : it easily separates, and, when the choroides is put into water, dissolves into a kind of black paint. This black substance seems to answer different purposes : thus in the choroides, properly so called, it absorbs the rays
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of light, and prevents the reflection of them again into the eye; on the back of the iris and between the ciliary processes, it prevents the passage of the rays through them, it being necessary to distinct vision that no rays should pass to the retina, but such as, entering at the pupil, pass through the crystalline humour.

Near where the sclerotica and cornea join, the choroides is connected and adheres strongly all round to the sclerotica. At this circle of adhesion the choroides seems to change its colour and texture, appearing as a whitish kind of ring of a compact substance, which serves to form this connection between the sclerotica and choroides, and is termed *ligamentum ciliare*. Here the internal lamina of the choroides dips inwards to make what are termed the *processus ciliares*, a name which is given to these processes, from their supposed resemblance to the cilia or eye-lashes. The ciliary processes, which are very numerous and lie close to one another, appear as radiated folds or wrinkles of the internal lamina from the part before-mentioned, and the external extremity of each fold respects the circle of the *ligamentum ciliare*. From this point the processes

cesses run upon the fore-part of the vitreous humour to the edge of the crystalline humour in which they are inserted and terminate, like lines drawn from a circumference to a center : the whole radiated ring made by the ciliary processes is sometimes distinguished by the name of corona ciliaris ; and it may be proper likewise, in order to prevent confusion, to observe that many writers describe these processes by the term of ciliary ligament. After the black pigment, which lies thick in these ciliary folds, is washed off, numerous blood-vessels, that are continued from the choroides, appear plainly in an injected eye ; and some of these enter into the crystalline humour. It is asserted likewise that between the duplicatures of the ciliary processes fleshy fibres may be seen lying in small grooves of the membrana vitrea ; but modern enquiries do not confirm the existence of these fibres. Upon cutting the coats of the eye, and separating the crystalline and vitreous humours from their adhesions to the ciliary processes, part of the pigment before-mentioned is left lying in black radiated lines upon these hu-

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mours: these lines, of which further mention will be made, are called ductus nigri; and between them it is said the muscular fibres are situated.

In regard to the uses of the ciliary processes, they serve, by being covered with the black pigment, to prevent any rays of light from falling on the retina, which have not passed first through the crystalline humour. They likewise send vessels both to the capsula and body of the crystalline humour, and others probably to the vitreous humour. There is also reason to believe that by their numerous villi they contribute very considerably to the secretion of the aqueous humour. One opinion of their use has been more generally received, namely, that by their contraction, the crystalline and vitreous humours are brought forward, making the cornea more prominent, as when we would view small and near objects distinctly; but as the existence of muscular fibres in the ciliary processes is by no means proved, it may be reasonably doubted whether the actions of these processes can have any power in the motion of those humours.

Having

Having described thus the ciliary processes as radiated folds or wrinkles, proceeding from that part of the internal lamina of the choroides which adheres to the ciliary ligament, it remains next to be observed, that the external lamina of the choroides, after it has formed the ciliary ligament, leaves the sclerotica; and being continued in nearly a transverse direction, makes the anterior lamina of the perforated partition, which is seen through the cornea lying across the eye, and is called the iris: the internal lamina of the iris is formed by a continuation of the internal lamina of the choroides, after it has dipped inwards in the manner above described and made the ciliary processes.

The hole or opening in the iris called the pupil, is observed to have a different form, in different animals, according to the situation or form of the eye itself, and according to the peculiar occasions of the animal in its way of life. In man the pupil is round, the circle of which allows of being made greater or less upon different occasions by means of the iris, which has a power of

shutting out too much light or admitting a sufficient quantity; according to the nearness or distance of the object, or according to the degree of light required: these motions are called contraction and expansion. It has been a dispute, whether these motions are the effect of muscular fibres or of a nervous tension and relaxation. Those who seem to have examined this affair carefully, agree in general, that there are between the laminæ of the iris, two orders of fibres, one circular or orbicular, and lying round the margin of the pupil or internal edge of the iris; the other radiated, one extremity of which terminates at the circular order, the other at the external edge of the iris. It is indeed exceeding difficult to discover the fibres said to produce the motions of the iris; but as it is certain, that the iris is contracted and dilated, it is reasonable to suppose, from the analogy of other parts, that muscular fibres subsist here and produce these actions.

The use of the pupil is to transmit the rays of light to the humours of the eye which are situated behind it: the use of the iris, as was before intimated, is by its dilatation and contraction

traction to determine the diameter of the pupil in any given quantity of light, so as to admit a sufficient number of rays for clear vision, and to exclude the rest.

The arteries, which in the description of the sclerotica, were said to penetrate through the posterior portion of that membrane, pass afterwards through the external lamina of the choroïdes and are diffused through this membrane in numerous branches, some of which, from their direction, are called *vasa vorticosa*. From the branches of the external lamina are continued the fine vessels of the internal or the *membrana ruyschiana*; and of these, some probably pass on to the vitreous humour as others do, by means at least of the ciliary processes, to the crystalline humour, contributing, it is to be believed, to the formation of those humours. From the vessels of the external lamina likewise are sent several ramifications to the circumference of the iris, where they produce a vascular circle called *circulus arteriosus*. From this vascular circle pass off many smaller vessels, some of which, after they have run about

two thirds of the breadth of the iris, inosculate and form the appearance of arches: from these arches are sent still finer vessels, terminating at the internal edge of the iris, and serving probably to secrete a part of the aqueous humour of the eye.

The veins of the choroides, and indeed of the other internal parts of the eye, empty their blood chiefly into the optic sinuses, to be conveyed to the internal jugulars: some of these veins however communicate with the external veins of the eye, and their blood is consequently carried to the external jugulars.

The nerves of the choroides proceed from the ganglion, formed by short ramifications of the opthalmic branch of the fifth pair of nerves and by a branch of the third pair. These run along the optic nerve, and perforating in white filaments the sclerotica, they pass afterwards between the sclerotica and choroides towards the iris; and then dividing again into several other very minute branches they terminate in the substance of the iris.

As an appendix to this article, it may not be improper to take notice here of the mem-
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brana pupillaris or velum pupillæ, an extremely fine membrane, of which very little has been said by writers, and which has not been at all attended to till of late years. Both in the human and brute fœtus a very fine membrane is spread like a film before the pupil: This membrane, which is discoverable only in a fœtus, is termed the membrana pupillaris or velum pupillæ, and seems to be a continuation of the external lamina of the iris. The use of the membrana pupillaris is not satisfactorily determined: some have supposed it serves to moderate the impression of the rays of light, and render them less troublesome to the tender organs of animals newly born; a plausible account at least, if not a true one. Agreeable to this, is the supposition, that after birth the membrana pupillaris bursts or breaks, and contracting itself, approaches to the edge of the pupil; but what really becomes of this membrane after birth is still uncertain.

THE RETINA.

WITHIN the internal lamina of the choroides is a white soft membrane, which from its supposed resemblance to a net, is called retina, and is the third coat of the eye.

As the sclerotica was said to proceed from the external or dura-matral covering of the optic nerve, and the choroides to be an expansion of the second or pia-matral coat, so the retina is supposed to be a production of the medullary substance of this nerve, expanded like a membrane; though it must indeed be allowed, that by laying open the coats of the optic nerve, its medullary substance cannot be clearly traced, as continuing on to form the retina.

At the bottom of the eye, just where the optic nerve is inserted, the choroides is deficient, in order to admit the passage of that nerve: at the same place there appears a small white protuberance a little depressed in its middle; and at this depression pass out blood-vessels, which in general are expanded, thro' the substance of the retina. These vessels proceed

ceed from an artery that runs in the middle of the optic nerve, and which, entering with that nerve into the globe of the eye, spreads afterwards in the manner just mentioned: Some of the blood-vessels appear plainly in the retina without the assistance of injections. The retina is connected to the choroides, and extends from the insertion of the optic nerve, over the surface of the vitreous humour, to the external edge of the ciliary processes; and some say it may be traced between the ciliary processes to the circumference of the crystalline humour.

The retina is generally supposed to be the immediate seat of vision; but this opinion has been controverted, and the choroides has been said to be the part which receives the impression of the object. It should seem however, by the impossibility of rays of light passing through the black pigment to the choroides, that the retina is the part of the eye upon which visible objects are sensibly impressed; and the rays of light striking upon this membrane, the sensation is conveyed by the optic nerves to the common sensorium in the brain.

It is observed that the center of this expansion, or the part of the eye where the optic nerve is supposed to enter, either on account of some particular disposition of the nerve at that place, or because the artery before-mentioned enters the eye there, is insensible. It appears therefore to be a wise contrivance of providence that the optic nerve should not enter the eye, in the point where the axis of vision falls, but is inserted on the internal side of the axis of vision; by which means, though some of the rays from any point of an object may happen to fall on the insensible part of one eye, yet other rays from the same point will fall on the sensible part of the other eye; for it is proved by experiment, that one eye being shut, three objects may be so placed as one of them may be lost, though visible when both eyes are open. The reason of this is, the object whose rays fall on the insensible part of one eye, is discoverable by other rays falling on the sensible part of the other eye.

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T H I R D L E C T U R E .

O F T H E H U M O U R S O F T H E E Y E .

TH E cavity of the eye is filled by pellucid substances called humours, which are three, the aqueous, the crystalline, and the vitreous.

T H E A Q U E O U S H U M O U R . All that space in the eye between the cornea and the anterior part of the crystalline humour, is filled with a limpid water, called therefore the aqueous humour. The space in which this humour is confined, is divided into two parts called chambers; that part between the cornea and the iris, and which is much the larger of the two, is called the anterior chamber; that part between the iris and the crystalline humour, which is very small, especially near the pupil where the crystalline comes almost into contact with the iris, is called the posterior chamber: these two chambers communicate

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municate by means of the pupil. The vessels which immediately furnish this fluid are so extremely fine, as makes it difficult to speak of them with certainty. It is however probable, that part of the aqueous humour is secreted from the blood, as was before observed, by the very fine vessels sent from the vascular arches described in the account of the iris, and which terminate at the internal edge of the iris, and that a considerable portion of it is supplied by the fine arterial villi of the ciliary processes. These vessels, it is to be supposed, by the smallness of their diameters exclude all particles of the animal fluids that are grosser than the most limpid water, at the same time that they suffer this fine fluid to pass into the eye. It is observable, that when a wound is made in the cornea, and the aqueous humour is discharged by this accident, it is renewed in a few days and sometimes sooner. From this observation, it is reasonable to suppose that the aqueous humour is perpetually secreted; and if it is thus constantly separated from the blood, there must necessarily be some means of carrying it off, since without this resource the cornea would be too much distended and protruded.

truded. The manner in which this superfluous humour is carried off is not clearly demonstrable ; but it is probable that part of it is taken up by absorbent veins, and part of it may transpire through the cornea. It is said that the aqueous humour is not perfectly clear in newborn infants, in order that their tender eyes may not at first be too violently affected by the light : it is further observed that in old age this humour sometimes changes its consistence, becoming thicker ; and likewise alters its colour, growing whitish ; by which means the rays of light do not pass so freely to the retina as usual : and this among other more common causes may be one reason of imperfect sight in old people.

The use of the aqueous humour is to keep the cornea distended, and in such a state of convexity as to refract the rays of light in a proper degree ; to preserve a due distance between the cornea and the crystalline humour ; and to serve as a proper medium for the iris to float loosely in, whereby its different actions may be performed more easily. Some likewise suppose the aqueous humour is necessary for

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for the crystalline to move in, that objects may be seen more distinctly at different distances.

THE CRYSTALLINE HUMOUR. Next to the aqueous is the crystalline humour, which is a transparent mass resembling crystal, whence it takes its name. It is situated between the other two humours, its anterior part being opposite to and very near the pupil; its posterior portion being lodged in a cavity formed for its reception in the middle and fore-part of the vitreous humour. The figure of the crystalline is that of a lens, convex on both sides but rather more so posteriorly. This humour, which is the least of the three, is of a much more firm consistence, particularly in the middle of it, than either the aqueous or vitreous; for this reason it has sometimes been called the crystalline body. In the center or more compact part, it feels like glue and may be easily pressed into different forms; but it gradually becomes of a less firm consistence, somewhat like a thick jelly, towards the outer surface. In time it is subject to change both its consistence and colour, growing still more firm, especially in the middle, and gradually taking a yellowish tinge.

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tinge. The cryſtalline humour is membranous, and conſiſts of a great number of coats incloſed in one another and connected mutually one to another by very fine fibres. — The cryſtalline is contained in a capſula formed by a continuation of the covering of the vitreous humour hereafter to be deſcribed. This capſula, which is ſometimes termed *arana*, is a fine transparent membrane, elastic, and rather thicker in its anterior than its poſterior part. It is furniſhed with veſſels from the ciliary proceſſes, and from an artery which enters at the bottom of the retina and runs through the vitreous humour, as will be further taken notice of in the deſcription of that humour. If the capſula be pricked with a needle, and a blow-pipe applied to the orifice, the air may be introduced between the capſula and the cryſtalline, and will form a ſmall transparent bladder. It has been obſerved likewiſe, that after pricking the capſula in this manner, a little clear water will ſometimes be diſcharged from the puncture; and it has been thought that the external portion of the cryſtalline body is of an aqueous nature, and that the middle and more ſolid
part

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part of it swims as it were in this water. It has been asserted, in consequence of this opinion, that the body of the crystalline humour has no connection or communication with the capsula, nor is nourished in the ordinary way by a circulation of fluids, but by absorption. This opinion, however, though it has been espoused by very eminent writers, does not appear to be sufficiently warranted; as there is good authority to believe that the vessels, which pass from the ciliary processes to the capsula, are continued from the capsula to the body of the crystalline. Admitting then such a continuation of vessels, which we must suppose to be extremely fine, it is reasonable to conclude that the capsula being elastic, will if punctured be drawn back in consequence of that elasticity, and that the fine vessels just mentioned, being necessarily torn by this means, the body of the crystalline will be separated from its proper coat, and water will ouze out from these lacerated lymphatics. Perhaps too the quantity of this water may be increased by the eye being examined after it has been kept some time, which may have occasioned part of the crystalline to dissolve.

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dissolve. The chief use of the capsula is to confine the crystalline humour in its proper situation, to which purpose the connection between the capsula and the vitreous humour, the manner of which will be explained in the next article, is subservient. To explain the uses of the crystalline itself, it has been supposed by some that the ciliary processes, which are partly inserted into the circular rim or anterior portion of the vitreous humour, will, when they contract, depress the vitreous humour; that this depression of the vitreous humour will push forwards the cavity that receives the posterior part of the crystalline, and of course the body of the crystalline humour will be protruded nearer to the cornea; but that when the ciliary processes are relaxed, the vitreous humour will return to its former situation, and the crystalline again recede nearer to the bottom of the eye. By this means it is imagined that the distance of the crystalline from the retina is occasionally fitted to the different distances of objects. The most acknowledged use of the crystalline humour is to pro-

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duce a second refraction of the rays of light, the first refraction, which is produced by the cornea and the aqueous humour, not being sufficient to bring them to a focus at the retina.

VITREOUS HUMOUR. The third and last of the humours of the eye is the vitreous, called so from its resemblance to melted glass. It occupies all the posterior, and indeed the greatest part of the globe of the eye: the consistence of it is thicker than the aqueous, but less firm than the crystalline; it is a very transparent mass, and has a good deal the appearance of a fine clear jelly; but if exposed some time to the air, it gradually collapses and wastes, a fine limpid water oozing through the membranes which give this humour its consistence; for the substance of this mass is composed of numerous little membranous cells or vesicles filled with a pellucid humour. It has already been hinted that the formation of this humour may be partly owing to a continuation of the vessels making the papillæ of the internal membrane of the choroides; but probably a considerable share of it is derived from
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the ramifications of a vessel, which proceeds from the artery that has already been described as running through the center of the optic nerve. The ramifications of this artery are indeed in general distributed on the retina; but there is one branch arising from it which passes quite through the vitreous humour, and spreads itself in a beautiful manner on the back of the capsula of the crystalline. This vessel gives off very fine lateral branches as it passes through the vitreous humour, and from these it is reasonable to suppose the pellucid humour above-mentioned, may be in a great measure secreted. In the middle and fore-part of this humour is a depression or cavity, which receives the posterior portion of the crystalline, and the margin of this cavity appears like a circular protuberance. On this circular protuberance are seen the little radiated channels before-mentioned, which are made by the ciliary processes as they pass to the circular edge of the crystalline, and which appear black at their bottom upon separating the crystalline and vitreous humours from their adhesions to the ciliary processes. This appearance

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of blackness is owing to the substance before described under the name of black pigment, which covers the ciliary processes, and of which part is now left at the bottom of these channels after the processes are removed.

The vitreous humour is covered with a coat that is perfectly pellucid, and is termed the tunica vitrea. It is contiguous to the retina, and is a double membrane. The internal lamina of this membrane is said to insinuate itself into the substance of the vitreous humour, in order to form the little cells or vesicles before-mentioned; but this humour having a depression or cavity, as has been just described, in which the posterior portion of the crystalline is lodged, the two laminae of the tunica vitrea separate when they arrive at the edge of this cavity: here the internal of these two laminae passes between the vitreous and crystalline humours, serving to line the cavity in which the crystalline lies, and to make the posterior part of its capsula; the other lamina passes over the crystalline, and becoming thicker and elastic, makes the anterior part of the capsula.

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The use of the vitreous humour is to fill up the back part of the eye, and together with the crystalline and aqueous, to preserve the due distance between the cornea and the retina; serving also with the other humours, so to refract the rays of light as they may converge to a point on the retina.

The different humours being described, it may not be improper here to add some remarks on the depression and extraction of the crystalline, when it is become opake and forms the disease called a cataract.

The dispute about the cataract, whether it be an opacity of the crystalline humour, or whether it be a film or membranous substance formed in the aqueous humour behind the iris does now no longer prevail. It is the general opinion at present that a cataract is an opacity of the crystalline. By what means was this dispute determined? by a method the most likely to destroy an erroneous theory and to establish a true one, by examining into the state of the parts after death. From this examination it appeared, that the crystalline humour was become more or less opake, and
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on the other hand, the supposed film or membrane was not to be discovered. The seat and nature of the cataract being in this manner established, the means of cure were more plainly indicated: either the opacity of the crystalline humour was to be cleared by medicine, or the humour itself was to be removed from its situation by an operation. The first of these has not been found practicable: there are no medicines yet discovered, which either internally or externally used, have the power of restoring the opaque crystalline humour to its natural transparency, 'Twas necessary therefore, in order to have the light transmitted to the retina, that this opaque body should be removed from its natural situation by an operation. Two ways have been practised for this purpose; the one to depress the humour, the other to extract it intirely out of the eye. The method by depression has generally been by passing an instrument, the couching needle, through the coats of the eye, into the crystalline humour, and pushing the humour gently down towards the lower and posterior part of the eye. The needle being then carefully withdrawn,

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drawn, and the crystalline left in this new situation, the rays of light are again transmitted through the vitreous humour to the retina ; and the defect in the refraction of these rays, for want of the crystalline in its natural situation, is to be supplied by a proper optic glass.

Whether the crystalline humour is by this operation always separated and dislodged from its cavity in the fore-part of the vitreous humour, or whether in attempting to do this, the vitreous is not sometimes turned and moved along with the crystalline humour, (from the strong connection between them by means of the capsula of the crystalline) is not easy to be determined. This is certain from experience, that it is much less difficult to depress the humour than to keep it depressed. The crystalline humour left at the lower part of the eye may be considered there perhaps not improperly as a foreign body, and having [in this place no particular cavity for its reception as it has in its natural situation on the fore-part of the vitreous humour, the common pressure upon different parts of the globe in the several motions of it, but particularly on its po-

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terior portion, by the contraction of the muscles when the eye is drawn inwards, would be very apt to protrude this foreign body again into the bed or cavity which nature originally prepared for it. So likewise the force of coughing, vomiting, or putting the head into some particular position, have been known to raise the cataract into view again; and if we allow that the vitreous humour may be turned or moved along with the crystalline, in the depression of the crystalline, 'tis equally probable that nature, ever solicitous to preserve the due order of her necessary functions, will by some such means as have been just now recited, replace this organ in its former situation.

Upon the whole, the frequent return of the opake crystalline into its natural position after it had been depressed, the troublesome symptoms which, though not often, yet sometimes ensued either from wounding the coats of the eye, lacerating the ciliary processes, or doing other injury to these delicate parts in the depression of the crystalline, made the success of the operation uncertain in general,
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and the effects in some instances disagreeable ; so that any other method of operating which carried with it a reasonable prospect of answering the purpose well, had a claim to consideration. Another method was proposed, and at first sight seemed so reasonable and proper, that, like many other discoveries, 'twas rather surprizing it should not be sooner brought into common use (for the general scheme of the operation appears to have been thought of before; and the operation had probably been practised by the remarkable, itinerant operator of our own country) than that it should now be received with approbation and eagerness. It had been observed, that in the operation by depression, the crystalline had sometimes been dislodged from its cavity in the vitreous and had come forward into the anterior chamber of the aqueous humour, and that upon such occasions an opening had been made in the cornea, and the crystalline successfully extracted. From this consideration, 'twas not unreasonable to try whether the opaque crystalline might not generally be extracted intirely out of the eye with
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safety and success, through a proper opening made for its passage in the cornea. An opening is made in the cornea in such a manner as to give room for the crystalline to pass through it; the crystalline either by the common motions of the eye or by a gentle pressure made upon the eye, is brought forward towards the anterior chamber of the aqueous humour; the capsula of the crystalline is divided in order to free the body of the crystalline from any attachments which might keep it back, and to prevent the vitreous humour from being drawn along and discharged with it; the crystalline is protruded and passes out through the opening made in the cornea. Thus the obstacle which hindered the transmission of light thro' the vitreous humour to the retina, is for ever removed, and the want of a due refraction of the rays occasioned by the discharge of the crystalline is to be supplied afterwards, as in the operation by depression, by an optic glass of a suitable convexity.

What has been the success of this method? not equal to what was wished and reasonably expected. Whether in the operation

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ration by extraction, the iris was sometimes wounded in passing the needle thro' the cornea or in dividing the capsula of the crystalline; whether it was over-distended or torn by the crystalline's passing through the pupil; whether in the expulsion of the crystalline the ciliary processes were lacerated, and an extravasation of blood ensued from a rupture of the fine vessels of these processes or of other parts of this delicate organ; or lastly, and what appears to me very probable, whether the quantity of air let into the eye by the large wound made in the cornea, injures the humours and the membranes that invest them, as often happens in some other cases where membranous parts are exposed to the air, is difficult to determine. This is certain, that tedious and painful inflammations are apt to follow the operation by extraction, and sometimes considerable imposthumations ensue: in consequence of these, adhesions have been formed; the figure of the pupil has been changed or the motion of it entirely lost; and sometimes the globe of the eye has wasted and been destroyed. Even the scar
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from the wound in the cornea, or the thickening of the cornea in consequence of the long-continued inflammation upon it, are apt sometimes to hinder the free admission of the light through it.

Upon these considerations the operation by depression, hitherto at least, seems preferable; and it may be further said, that the operation by extraction may be afterwards practised if the other method should prove ineffectual. In regard to the method by depression, as the symptoms attending it are seldom very bad, and are free from danger; as some cases admit of a reasonable hope of success; and even when success is wanting, as the patient is left much in the same state as before the operation was performed; where the circumstances of the case are such as are commonly judged proper for the operation, it ought certainly to be recommended.

The next and the last parts to be considered, are the muscles.

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THE eye, thus curiously constructed to admit the rays of light and to receive the impresson of external objects on the bottom of it; placed likewise in a situation the most favourable for commanding the view of objects; and lodged in a bony cavity serving to secure it against many accidental injuries; would with all these advantages, have been much circumscribed in its uses, if it had been fixed in the socket without the power of being occasionally moved in different directions, according to the position of the object to be viewed. In order therefore to answer the important purposes of vision most effectually, the eye-ball is made capable of various motions, and is furnished with a proper apparatus of muscles for the performance of those several motions. Each eye has six muscles; four of which are called right or strait muscles; and they receive likewise other denominations relative to their situation, functions, or some power which they are supposed to have in expressing particular affections

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fections of the mind. Thus one is called rectus superior, attollens, or elevator, and superbus; another is termed rectus inferior, depressor, and humilis; a third has the names of rectus exterior, abducens, and indignatorius; a fourth is styled rectus interior, adducens, and bibitorius; all these strait muscles arise by short narrow tendons from the bottom of the socket near the hole which gives passage to the optic nerve: they soon become fleshy, and running over the posterior part of the globe of the eye, are inserted into the anterior parts of the sclerotica by thin broad tendons, which by their expansions unite with one another, and are continued on to form the white of the eye.

The musculus rectus superior, passing over the upper part of the globe of the eye, is inserted into the superior and anterior part of the sclerotica; the rectus inferior passes along the under part of the globe, and is inserted into the sclerotica opposite to the insertion of the preceding muscle; the rectus exterior runs on the side of the globe next the temple, and is inserted into the sclerotica on the same side; the rectus interior passes on the side of the globe next the nose, and is inserted into the
sclerotica

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sclerotica on that side, and opposite the insertion of the former.

When these muscles act singly, they serve either to lift the eye-ball upwards, or turn it downwards, to move it outwards or turn it inwards, according to the respective action of each muscle. Thus the rectus superior raises the anterior portion of the globe of the eye upwards when we lift up our eyes; the rectus inferior brings it downwards, when we turn the eye in that direction: the rectus exterior serves to move the globe sideways towards the temple; and the rectus interior to turn it inwards towards the nose. When two neighbouring straight muscles act together, they give the eye some degree of obliquity in its motion, as when the rectus superior and the adductor move together, they turn the eye obliquely upwards and towards the great angle; and so of the others: These last motions have been supposed to be effected by the oblique muscles. When all these muscles act successively, they give the appearance of a rotatory or rolling motion to the eye. If all the straight muscles act with equal force and at the same time, they are said to draw the eye-ball in some degree towards the bottom of
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the socket, and to keep it as it were fixed and directed right forward. It is thought likewise that by drawing the eye towards the bottom of the socket, the posterior part of the eye may be so compressed against the fat contained in the socket, as to shorten the distance between the retina and cornea : at the same time the humours of the eye are supposed to be protruded forwards; and to render the cornea more convex, by which means the eye, it is imagined, is fitted to see small or near objects distinctly.

Besides these four straight muscles there are two others, which from their direction, are called oblique. They are distinguished by the names of obliquus major or superior, and the obliquus minor or inferior. The first of these is likewise termed trochlearis, from the tendon of this muscle passing through a cartilaginous pulley that is situated in the orbit near the great or inner angle of the eye. The two oblique muscles together are by some named circumagentes and amatorii, from the power which they were supposed to have of winding or rolling about the eye in the manner of looking that is commonly termed ogling.

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The musculus obliquus major or superior arises tendinous from the bottom of the socket; near the entrance of the optic nerve, and passing towards the upper part of the socket near the great angle of the eye, the round tendon of this muscle runs through a cartilaginous pulley, which is there fixed to a depression in the os frontis. From thence it is reflected and runs obliquely backwards inclosed in a ligamentous sheath, and is inserted tendinous into the sclerotica upon the upper part of the globe of the eye, a little more backward than the insertion of the rectus superior.

The musculus obliquus minor or inferior arises chiefly fleshy, just within the edge of the lower and anterior part of the socket near the nose, and passing obliquely backwards under the globe is inserted into the sclerotica on the external side of the eye.

When the first of these muscles, the obliquus major or superior, acts singly, it rolls the eye about its axis, drawing the globe forwards and turning the pupil downwards; when the second, the obliquus minor or inferior,

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rior, acts singly, that too rolls the eye about its axis, serving likewise to draw the globe forwards; but turns the pupil upwards. When both the oblique muscles act together, they draw the eye outward from the socket, serving by this means as antagonists to counteract the power of the straight muscles, which, when they all act together and with equal force, draw the eye-ball backwards; and even when they act singly, in the performance of their other motions, they have some tendency to draw the eye-ball backwards. The oblique muscles are thought likewise to have a further use in bringing the eye-ball forwards or outwards from the socket, as thereby they take off all pressure from the back part of the eye, and fit the form of the eye to view distant or large objects distinctly.

The muscles of the eye-ball are furnished with blood-vessels from the external carotid artery, by means of the internal maxillary artery: The branch of the internal maxillary, which has been described to enter the socket and to be divided there into several ramifications, gives some to these muscles.

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The nerves which pass to these muscles are from the third, the fourth, and the sixth pair.

The third pair of nerves, or as they are likewise called, the motory pair or movers of the eyes, give a branch to the superior, to the inferior, and to the internal right muscles; also another branch to the inferior oblique muscle. The fourth pair, or as they are sometimes called, the pathetic pair, are spent on the superior oblique muscles; and the sixth pair of nerves are sent chiefly to the exterior right muscle or abducens.

C O N C L U S I O N.

HA V I N G endeavoured thus to give a plain account of the structure and uses of the eye and eye-lids, I have proceeded in this subject as far as the duty of my office requires. It might however have been no unpleasing task to have recapitulated and given in one collected view the various uses to which the several parts described are most admirably subservient; but as I may already have engaged more of your time than has been agreeable to your convenience or inclination, I shall only beg leave to take notice in general terms——of the situation of the eye, as it is placed in that part of the body which is most advantageous for commanding the view of objects——of the figure of the eye, which with the contained humours, is best calculated to receive and refract the rays of light, so as to form a distinct picture of external objects upon the bottom of it——of the manner in which the eye is connected to the socket, by which means it is properly retained there, and
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yet is capable occasionally of a free movement in different directions without pain or inconvenience——of the defence with which nature has furnished this organ against many external accidents, by inclosing the greatest part of it in a firm, bony cavity or case——of the lodgement of it upon a soft yielding bed of fat, which facilitates the motions necessary to vision, prevents the injuries of pressure from these motions, and keeps the parts in a due state of softness and flexibility——of the various movements which the eye is capable of, by means of its several muscles, according as the different situation of the object to be viewed requires——of the coats or coverings of the eye, and the substances called humours contained in those coats, for the production of the necessary refractions of the rays of light——of the power which the eye has by the expansion and contraction of the pupil to admit a sufficient quantity of light or exclude too much, according to the distance or nearness of the object to be viewed, or according to the degree of light it is seen in which is almost perpetually varying —— lastly of the number, the

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course and the fineness of the blood-vessels and nerves serving for the constant supply of the humours, and for the due nourishment and sensation of the other parts of the eye. — There is one observation more, which arises indeed so naturally from the subject as to make the mention of it here hardly necessary—every sensible and feeling mind will reflect with pleasure, admiration and reverence, on the infinite art and wisdom, which are so remarkably displayed in the structure and uses of this exquisite organ.

The E N D.



